1891MNRAS..51..436C

On a New Dome to be erected at the Royal Observatory, Greenwich.

By W. H. M. Christie, M.A., F.R.S., Astronomer Royal.

In the last Report of the Council (*Monthly Notices*, vol. li., p. 209) mention was made of a proposal to replace the existing wooden south-east dome (of cylindrical form) by an iron-framed dome of larger diameter, better suited to the new 28-inch refractor, which is now nearly ready. This proposal has received the sanction of the Admiralty, and the new dome is now being constructed by Messrs. T. Cooke and Sons, of York. As the conditions which it has to satisfy are peculiar, and as the plan proposed presents some novel features, it may be of interest to give a general description of it.

In order to accommodate the new 28-inch refractor of 28 feet focal length, a dome of 36 feet diameter is desirable; but as the external diameter of the circular wall-plate on which the dome runs is only 31 feet 4 inches, a peculiar form of dome is necessary. The form adopted is the surface generated by the revolution of an involute of a circle, 7 feet in diameter, with its centre in the plane of the rail, and 5 feet from the axis, the curve being completed near the apex by an arc of a circle (of 13 feet 3 inches radius) so that it cuts the axis at right angles. The diameter of the dome is 36 feet at a height of 7 feet above the rail, contracting to 31 feet at the plane of the rail. The varying curvature of the involute appears to be well adapted to the conditions, the contraction in the lower part of the dome to the diameter of 31 feet being rapid, owing to the sharp curvature, while the increasing curvature towards the apex gives ample height, and improves the appearance of the dome.

The framework of the dome is to be generally similar to that of the Lassell dome (constructed by Messrs. T. Cooke and Sons), consisting of T-iron vertical curved ribs, tied together by horizontal circular ribs (of T or angle iron) cut through at the shutter-opening on both sides of the zenith, the opening being framed with vertical girders connected by a strong broad-flanged rib at the apex of the dome. As the centre of the instrument is two feet south of the axis of the dome and tower, this connecting-rib would not interfere with the view of the zenith. The base of the framework will be a stiff circular girder, 18 inches deep, the section of the girder being a right-angled triangle, the hypothenuse of which is formed by the ribs and papier-mâché covering of the dome. Thus the dome virtually consists of two semi-domes, resting on the continuous circular girder, and tied together at the zenith. It is proposed to use some form of papier-mâché as the covering of the dome, the vertical T-ribs being outside the covering, with the flat face towards the paper, and the horizontal circular ribs inside, also with the flat face towards the paper.

1891MNRAS..51..436C

The revolving arrangements will be similar to those introduced by me in the Lassell dome, viz. a system of vertical rollers, about two feet in diameter, attached to the circular girder of the dome, and running freely on a planed horizontal rail, the bearing-surface of the rollers being slightly rounded, so as to avoid any drag. Excessive lateral motion from the force of the wind, or other cause, is prevented by horizontal rollers carried on the same bracket as the vertical rollers, and so adjusted as only to come into bearing occasionally against the vertical face of the rail, when required to keep the vertical rollers from running off the rail. This system has been found to work very satisfactorily in the case of the Lassell dome, which runs very lightly after seven years' use.

The arrangement of the shutter is another matter which has required careful consideration. In the plan adopted I have aimed at securing the conditions:—(1) that there should be a wide opening, (2) that the shutter should open easily, (3) that it should present a symmetrical appearance externally, and (4) that the opening should be of the same width throughout on both sides of the zenith, so as to allow the air to pass freely through in the neighbourhood of the object-glass. The shutter, as arranged, is in two parts, with a division right down the middle, each half being a balanced shutter, 3 feet 6 inches wide, which extends right over the dome from the curb, through the zenith to the opposite part of the curb, and traverses to one side on a narrow rail (about 13 feet long) at the zenith, and on two broad rails attached to the opposite part of the curb at the bottom of the shutter on each side of the zenith. Each half of the shutter runs on a double-flanged bearing-wheel (say 1 foot in diameter), which it carries nearly vertically over its centre of gravity (so that it nearly balances on it, leaving a small excess of weight on the outer side), and it also carries a smaller double-flanged guiding-wheel on a stiff tail-piece, extending across the shutter opening to the other end of the rail. The flanged bearing-wheel runs on the upper side of the rail, and the guiding-wheel on the under side, so that it does not interfere with the bearing-wheel of the other half of the shutter. The tail-pieces (about 7¼ feet long) are bolted to the edges of their respective shutters on either side of the zenith, so that they run clear of each other when the shutters are opened. To guard against the possibility of the shutter being lifted by the wind, the tail-pieces may carry a supplementary roller (between the bearing and guiding rollers) running clear below the rail and just above a guard-rail fixed below it. The rail and the bearing and guiding wheels are under the shutter and covered by it when closed. Near the zenith the parallel curved girders of the shutter-opening, and the parallel outside edges of the shutters, are replaced by arcs of an horizontal circle (say 13 feet in diameter), allowing space under this part of the shutter for the rail (13 feet long), wheels, and guiding-pieces. Thus an opening, 7 feet clear throughout on both sides of the zenith, can be obtained when the shutters are opened to their fullest extent. The arrangement adopted for the tail-pieces in combination with the circular form of the shutter near the zenith, allows of a greater length in the guide for traversing the shutter. The weight of the shutter is carried chiefly by the bearing-wheel at the zenith, and in a small degree by wheels (without flanges) at the bottom of the shutter on each side of the zenith, which run on rails without lateral constraint, and serve to maintain the balance. Horizontal rollers (with flanges underneath) mounted on the same brackets would also serve for this purpose, and as wind-guards to prevent the shutter being lifted by the wind. The shutters may be opened and shut by means of tackles attached near the zenith.

The figures show the general arrangement of the dome. Fig. 1 is a sectional elevation of the dome and tower, showing the divided shutter, the circular girder with vertical and horizontal rollers, and the horizontal circular ribs. The two semicircles (dotted) are the generating circles of the involute. The position of the centre of the equatoreal is indicated by a cross. Fig. 2 is a plan of the dome, above the equator, showing the vertical and horizontal ribs, the broad-flanged connecting-rib, and the shutters with the tail-pieces, rollers, and rail. The dotted circle represents the 28-inch object-glass pointing to the zenith. Fig. 3 is a vertical section showing the shutters with the tail-pieces, rollers, and rails, at the zenith and at the bottom. The dotted lines indicate the position when the shutters are open. The three rollers connected by lines are attached firmly to the left-hand shutter, the upper left-hand and lower right-hand rollers being double-flanged wheels which run on the upper and under sides of the upper rail respectively, and the intermediate (lower) roller being a guard-wheel between the upper and lower rails to prevent the other two wheels being thrown off the rail by the action of the wind. The rollers at the bottom are without flanges, and are carried by brackets, so that when the shutters are opened they pass clear behind the vertical girders of the opening, and run on a rail fixed on the circular girder entirely within the dome.

Royal Observatory, Greenwich :
1891 *May* 7.

1891MNRAS..51..436C

Photographs of Neptune and its Satellite. By Isaac Roberts, F.R.S.

Sixteen photographs of the planet *Neptune* were taken at my observatory between December 9, 1890, and February 24, 1891, with exposures of the plates varying between fifteen minutes and three hours respectively. Upon eight of the plates the satellite is to be seen, and I have prepared the accompanying diagram to show its positions by measurements of the eight plates. The diameter of the photographic image of *Neptune* in my telescope is about equal to the major axis of the projected orbit of the satellite. The satellite can, therefore, be photographed only when it is somewhere within the distance of about 45° of the line of apsides, and if the planet did not mask the satellite in the other parts of its orbit the orbital motion would be too rapid to permit a photographic image being formed.

The large circle, fig. 1, represents the photographic image of *Neptune*, and the eight small circles around it those of the satellite. It is difficult to measure with accuracy the position angles of the satellite, because its image is generally very faint and undefined in outline by reason of the orbital motion; and the relatively large image of the planet adds to the difficulty in finding the line joining their centres. The position angles given in the following table are the nearest approximations practicable under these conditions.

Approximate position angles of the satellite :—

	°	′
No. 1, 1890, December 9, exposure 3 hours; sidereal time, 5h. 25m....	59	28
No. 2, 1890, December 12, exposure 15 minutes; sidereal time, 4h. 59m.	232	40
No. 3, 1891, January 10, exposure 60 minutes; sidereal time, 4h. 14m.	261	46
No. 4, 1891, February 1, exposure 84 minutes; sidereal time, 5h. 31m.	31	29
No. 5, 1891, February 4, exposure 50 minutes; sidereal time, 5h. 4m.	207	6
No. 6, 1891, February 10, exposure 75 minutes; sidereal time, 6h. 5m.	193	55
No. 7, 1891, February 20, exposure 90 minutes; sidereal time, 6h. 54m.	277	3
No. 8, 1891, February 24, exposure 75 minutes; sidereal time, 6h. 45m.	44	53

The sidereal time given in the above table is that at the middle of each exposure for the meridian of Crowborough, 37^{s} East of Greenwich.

On December 12, 1890, *Neptune* was in conjunction with the star D.M., +19°, 699, R.A. $4^{h}\ 11^{m}\ 17^{s}\cdot5$, dec. +19° 24′·6, mag. 9.4, and the relative positions of the star, planet, and satellite are shown on the diagram, fig. 2. At sidereal time $4^{h}\ 59^{m}$ the position angle of the planet and star was 118° 5′, and that of the satellite 232° 40′. The distance of the planet and star, measured from centre to centre, was 10″·85 of arc. The